MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

EME3276 – MECHANICAL DESIGN II

(ME)

22 OCTOBER 2016
9:00 a.m – 11:00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 5 pages including cover page.
2. Attempt ALL questions.
3. Please write all your answers in the answer booklet provided. Show all relevant steps to obtain maximum marks.
4. You may use the appendices provided in the booklet.

Question 1

(a) A helical compression spring is to be made of oil-tempered wire of 5 mm diameter with a spring index of C=10. The spring is to operate inside a hole (without clearance), so buckling is not a problem and the ends can be left plain. The free length of the spring should be 110 mm. A force of 60 N should deflect the spring 18 mm. (Use Bergsträsser factor K_B in your calculations)

i. Determine the minimum hole diameter for the spring to operate in. **[2 marks]**

ii. Determine the total number of coils needed. **[3 marks]**

iii. Determine the solid length. **[1 mark]**

iv. Determine a static factor of safety based on the yielding of the spring if it is compressed to its solid length. **[9 marks]**

(b) The extension spring shown in the Figure Q1(b) has full-twisted loop ends. The material is music wire A228. The spring has 12.17 coils and is close-wound with a preload of 5 N. (Use Bergsträsser factor K_B in your calculations)

i. Find the free length L_0 of the spring. **[3 marks]**

ii. Find the torsional stress only in the body of spring corresponding to the preload. **[3 marks]**

iii. Estimate the spring rate. **[4 marks]**

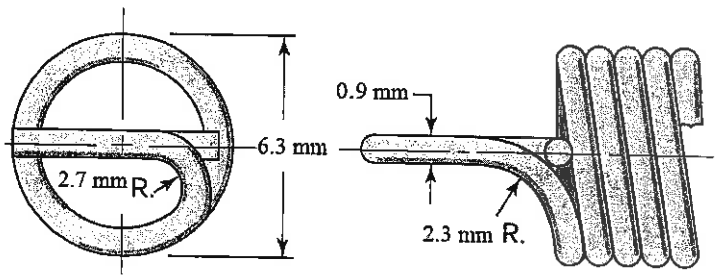

Figure Q1(b)

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Question 2

The Figure Q2 shows an internal rim-type brake having an inside rim diameter of 340- mm and a dimension R=140 mm. The shoes have a face width of 40 mm and are both actuated by a force of 2.5 kN. The friction surface of the brake shoes is 90° and centrally located. The mean coefficient of friction is 0.28.

(a) Find the maximum pressure and indicate the shoe on which it occurs.

[10 marks]

(b) Estimate the braking torque effected by each shoe, and find the total braking torque.

[5 marks]

(c) Estimate the resulting hinge-pin reactions on the right-hand shoe.

[10 marks]

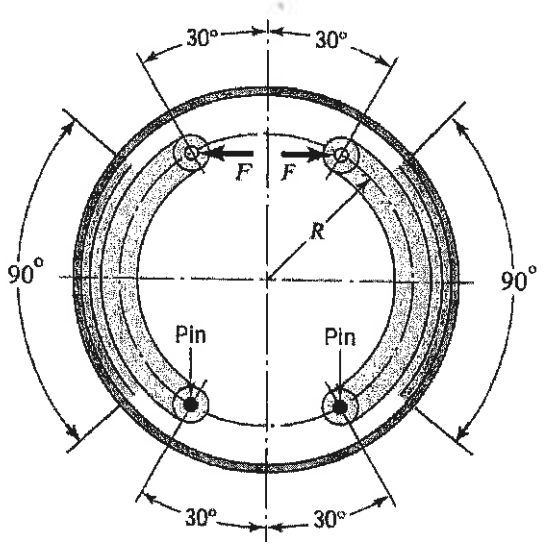

Figure Q2

Continued .....

Question 3

(a) A 45-kW four-cylinder internal combustion engine is used to drive a machine. The drive consists of two identical sheave pulleys with diameter of 660 mm spaced about 13.6 m apart. They rotate with speed of 400 rev/min. (service factor K_s=1.4)

i. How many number of V-belts are needed if D9000 is selected?

[10 marks]

ii. Estimate the initial load F_i of each belt. (coefficient of friction f=0.5123)

[5 marks]

(b) A parallel helical gearset uses a 20-tooth pinion driving a 48-tooth gear. The pinion has a right hand helix angle of 30°, a normal pressure angle of 25°, and a normal module of 3 mm.

i. Find the normal, transverse, and axial circular pitches.

[3 marks]

ii. Calculate the transverse module and the transverse pressure angle.

[2 marks]

iii. Determine the addendum, dedendum, pitch diameter of each gear and the theoretical center-to-center distance.

[5 marks]

Continued.....

Question 4

(a) Shaft "a" shown in the Figure Q4(a) has a power input of 90 kW at a speed of 1200 rev/min in the counterclockwise direction. The gears have a module of 5 mm and a 25° pressure angle. Gear 3 is an idler.

i. Determine the direction and rotation speed of gear 4. **[2 marks]**

ii. Determine and draw forces on gears 2, 3 and 4. **[10 marks]**

iii. Calculate the force that gear 2 exerts against shaft b. **[1 mark]**

iv. Calculate the torque that gear 4 exerts on shaft c. **[2 marks]**

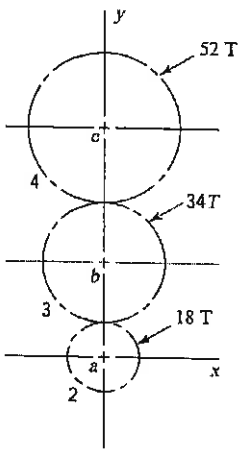

Figure Q4(a)

(b) An O-ring is assembled in the high pressure vessel shown in the Figure Q4(b). By redrawing this figure on your paper answer the following questions.

i. Based on the O-ring location, determine the direction of pressure and explain your reason. **[3.5 marks]**

ii. Determine the internal diameter of the O-ring if the desired stretch is 2%. **[2 marks]**

iii. Explain three limitation of O-Ring Use. **[4.5 marks]**

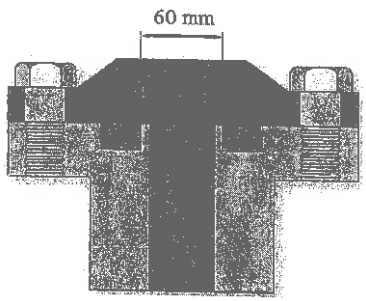

Figure Q4(b)

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